Surgical treatment of vertigo

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In 1966, following a visit to William House in Los Angeles, we developed a surgical approach to excise the meatal segment of the vestibular nerve through the middle cranial fossa. This operation—called 'vestibular neurectomy' or 'scarpectomy'—was designed to relieve the symptom of vertigo caused by a peripheral vestibular disorder while preserving hearing. In this paper we will report on the 5 year follow-up results obtained by the surgical treatment of vertigo in 90 patients representing 22 per cent of the cases seen at the E.N.T. Department of the University of Zürich with the clinical triad of deafness, tinnitus, and episodic vertigo between 1967 and 1970. The diagnosis of Menière's disease was made in each operated case after exclusion of any known aetiology for the observed symptoms. Although vestibular neurectomy was performed in more than 50 per cent of the instances, our discussion will not be confined to this operation alone, but include the results obtained by all the surgical procedures used.

These latter (Table I) may be divided into 3 groups. Saccotomy with

TABLE I.
SURGICAL TREATMENT OF MÉNIÈRE'S DISEASE

Operation	Hearing loss
1. Saccotomy with Myo-Synangiosis	Fluctuant, normal hearing in intervals of disease
2. Vestibular Neurectomy (Scarpectomy)	Stabilized or fluctuant in intervals of disease
3. Decompression of internal auditory canal with arterial transposition	Stabilized or fluctuant in intervals of disease with associated signs of central vestibular dysfunction
4. Cochleo-vestibular Neurectomy	Total
5. Transmeatal Labyrinthectomy	Total, general anaesthesia contraindicated

Operations used for the surgical treatment of Menière's disease. The hearing loss of the patient determines the choice of the appropriate procedure.

myo-synangiosis as well as the decompression of the internal auditory canal with arterial transposition are aimed to preserve the cochleo-vestibular function and are therefore *conservative procedures*. The excision of Scarpa's ganglion (vestibular neurectomy or scarpectomy) eliminates the first vestibular neuron while preserving hearing and can therefore be defined as a *semi-destructive procedure*. Labyrinthectomy and cochleo-vestibular neurectomy (section of the VIIIth nerve) are purely *destructive procedures*.

Surgery was considered indicated when medical treatment failed to control disabling symptoms during a period of at least six months. Since no medication can cure Menière's disease, the conservative treatment was mainly aimed to assess the spontaneous evolution of the disease while controlling symptoms and gaining insight into the psychology of the patient and particularly into the motives driving him to seek surgical relief from his symptoms. This last point is particularly important when planning a semi-destructive or totally destructive procedure, since in this case the surgical relief from episodic vertigo is followed by the complete unilateral loss of vestibular function. The time needed for as well as the final extent of compensation after surgically induced unilateral vestibular loss has been found to be inversely proportional to the interest shown by the patient towards reintegration into a normal family life and working process (Fisch, 1973).

The choice of the appropriate surgical procedure mainly depended upon the extent of the hearing loss of the patient (Table I). The indications, technique, complications, and results of each operation are reviewed separately.

Saccotomy with myo-synangiosis

In presence of a *fluctuant hearing loss* (particularly of a low tone type) with normal hearing in the intervals of the disease, one can assume that the underlying pathology still is in a *reversible stage*. Under these circumstances it is reasonable to try to arrest the evolution of the disease by improving the function of the endolymphatic sac which, most probably, is at the origin of the observed symptoms. The *technique* used to achieve this goal consisted in a broad exposure of the endolymphatic sac including its intermediate portion which, according to Lundquist (1965), is mainly responsible for the reabsorption of endolymph. The external aperture of the endolymphatic duct was identified by palpating its medial lip with a blunt hook. In presence of a reduced pneumatization the exposure of the blue line of the posterior semi-circular canal was helpful to safely reach the most internal portion of the sac. A pedicle flap from the temporalis muscle was introduced into the open lumen of the sac at the end of the procedure in order to possibly enlarge its reabsorbing inner surface and increase its vascular supply (Fig. 1, A and B).

The 5 year follow-up *results* of saccotomy with myo-synangiosis are presented in Table II. The operation was successful from a subjective point of view in 52 per cent of the patients. The attacks of vertigo disappeared in 48 per cent. The hearing remained unchanged in 48 per cent and became worse in 52 per cent. One patient (4 per cent) experienced the *complication* of a total hearing loss in the immediate post-operative period. The tinnitus disappeared or diminished in 8 per cent and 35 per cent respectively of the cases. The sensation of pressure in the ear was relieved or improved in 56 per cent and 36 per cent respectively.

(*Figs. 1, 2 and 3:* from Fisch, U., in Naumann, H. H. (Editor): Kopf- und Halschirurgie. Georg Thieme Verlag, Stuttgart. Vol. 3, CH 10, 1975.)

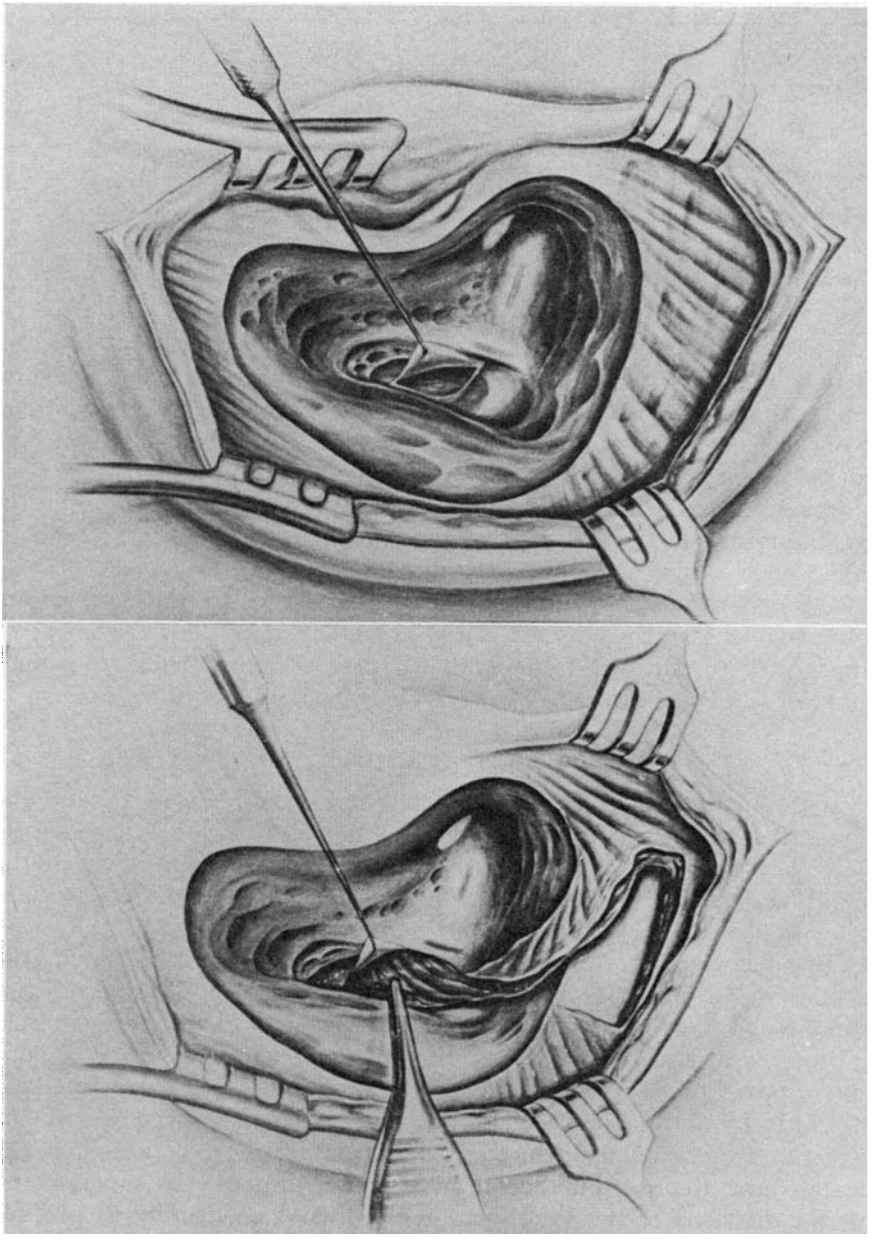

FIG. 1.

Saccotomy with myo-synangiosis.
A: Incision of the lateral wall of the sac after its exposure.
B: Introduction of a pedicle flap from the temporalis muscle into the lumen of the sac.

TABLE II.

SACCOTOMY WITH MYO-SYNANGIOSIS: 5 YEARS' FOLLOW-UP RESULTS IN 25 PATIENTS

Successful	(subject)	13/25	52%
Vertigo	gone	12/25	48%
Hearing	improved	0/25	—
	unchanged	12/25	48%
	worse	12/25	48%
	lost	1/25	4%
Tinnitus	gone	2/25	8%
	improved	9/25	35%
Pressure	gone	14/25	56%
	improved	8/25	36%

5 years' follow-up results in 25 patients submitted to saccotomy with myo-synangiosis.

The 5 year follow-up results of saccotomy and myo-synangiosis are slightly inferior to those obtained at the 2 year follow-up by G. E. Shambaugh (1975) using a Portmann type of procedure and the shunt operation. If one considers that only the complete relief of vertigo has been considered in our statistical analysis, and that many subjective variables are involved in the assessment of symptoms like tinnitus and pressure in the ear, the results of the above mentioned operations become very comparable.

Our experience with saccotomy and myo-synangiosis for the treatment of 'reversible' Menière's disease can be summarized as follows: The operation is easy to perform, relieves 50 per cent of the patients from their symptoms and carries a risk of total deafness in 4 per cent of the cases.

Vestibular Neurectomy

If the hearing loss of the patient selected for surgery is stabilized or fluctuates without reverting to normality in the intervals of the disease, the underlying pathology has reached an *irreversible stage*. In this case the operation of choice is the excision of the meatal segment of the vestibular nerve (vestibular neurectomy or scarpectomy).

The *technique* of this procedure—which is performed through the middle cranial fossa—is well known (Fisch, 1970, 1973). The superior semi-circular canal is used as landmark in order to identify the internal auditory meatus. This latter structure is found within a sector of bone limited posteriorly by the blue line of the superior semi-circular canal and anteriorly by an imaginary line forming an angle of 60 degrees with the former and is centred over the superior ampulla. Following incision of the meatal dura, the vestibulo-facial anastomoses are cut, the superior and inferior divisions of the vestibular nerve divided as distally as possible (Fig. 2, A), the artery supplying Scarpa's ganglion is coagulated bipolarly (Fig. 2, B) and the entire meatal segment of the vestibular nerve excised by using a pair of micro-neurectomy scissors (Fig. 2, C and D).

The goals of vestibular neurectomy are:

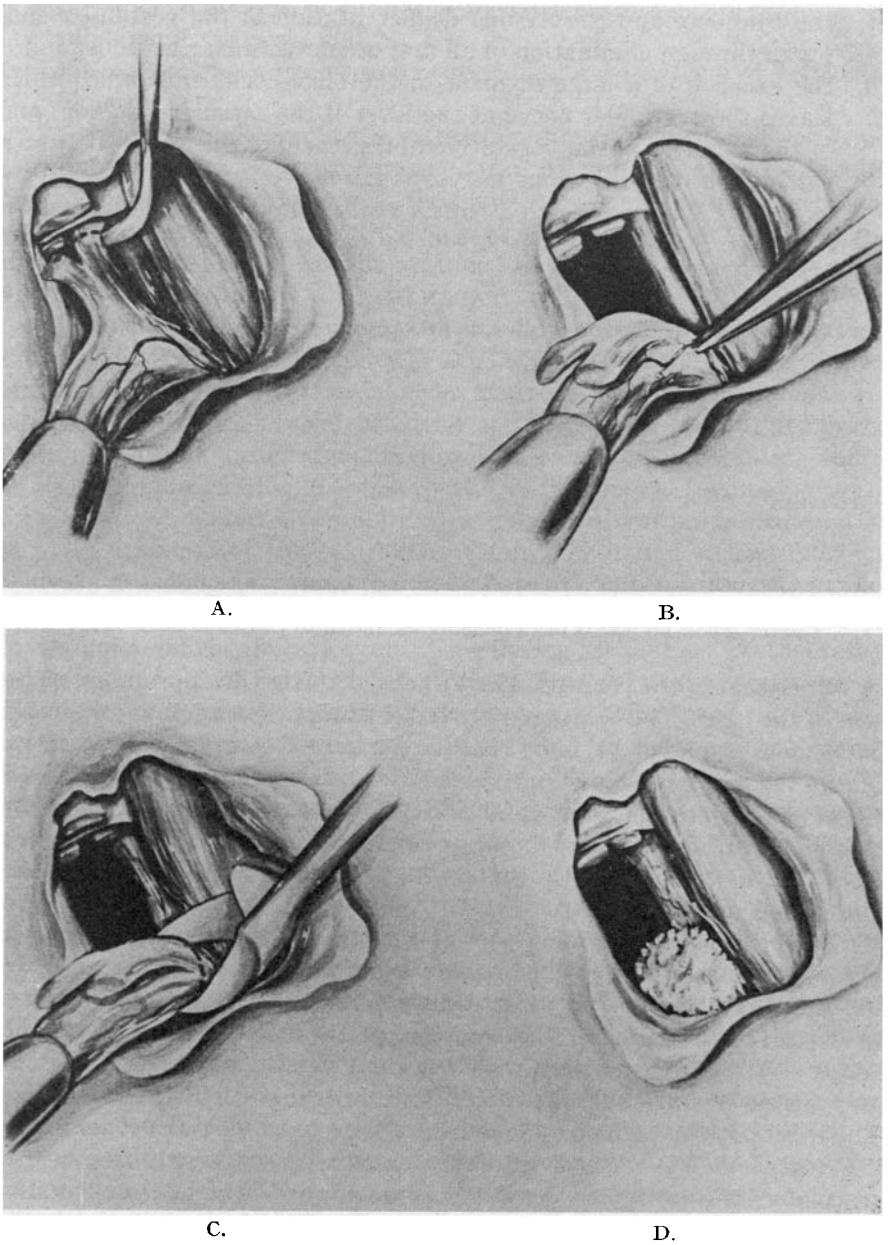

FIG. 2.
Vestibular neurectomy.
A: Distal section of the superior and inferior divisions of the vestibular nerve.
B: Bipolar coagulation of the artery of Scarpa's ganglion.
C: Proximal section of the vestibular nerve trunk.
D: The meatal segment of the vestibular nerve has been excised. The cochlear nerve is partially visible underneath the facial nerve.

(a) the complete and irreversible deafferentation of the vestibular end-organ through elimination of all first order vestibular neurons; and
(b) the excision of a large segment of the olivo-cochlear bundle (which leaves the vestibular nerve at the level of the saccular ganglion) and of the majority of the vegetative fibres reaching the inner ear (which run in their majority along the vestibular nerve).

The *results* obtained in 52 patients 5 years following vestibular neurectomy are seen in Table III. The operation has been qualified as successful

TABLE III.

VESTIBULAR NEURECTOMY: 5 YEARS' FOLLOW-UP RESULTS IN 52 PATIENTS

Successful	(subject)	48/52	92%
Vertigo	gone	49/52	94%
Hearing	improved	8/52	16%
	unchanged	33/52	64%
	worse	8/52	16%
	lost	2/52	4%
Tinnitus	gone	17/52	33%
	improved	17/52	33%
Pressure	gone	24/52	47%
	improved	8/52	16%

5 years' follow-up results in 52 patients submitted to vestibular neurectomy.

by 92 per cent of the patients. The attacks of vertigo disappeared in 94 per cent of the cases. The hearing improved (by more than 15 db in the speech frequencies' range or by more than 20 per cent discrimination) in 16 per cent of the cases, remained unchanged in 64 per cent and became worse in 16 per cent. A postoperative total deafness occurred in 2 (4 per cent) of the cases. Tinnitus disappeared in 33 per cent and was reduced in 47 per cent. The sensation of pressure in the ear had disappeared in 47 per cent and diminished in 17 per cent.

One of the three patients with recurrent episodic vertigo after vestibular neurectomy had an incomplete excision of the meatal segment of the vestibular nerve. The recurring symptoms were however so reduced in intensity and limited in time that the patient refused to consider further surgery. The second patient with recurrent vertigo had bilateral disease and was successfully submitted to a contralateral vestibular nerve section. The third patient—who had been free of symptoms for three years following scarpectomy—was subsequently submitted, without success, to a translabyrinthine cochleo-vestibular neurectomy. We have no explanation for the persistence of the episodic vertigo after VIIIth nerve section in this patient having no signs of contralateral disease or of central vestibular dysfunction.

The *complications* of vestibular neurectomy are:

(a) total deafness in 4 per cent of the cases,
(b) a delayed transitory facial paresis occurring 4–8 days following

surgery in 6 per cent of our initial 100 patients and in 3 per cent of the subsequent 150 cases, and

(c) the incomplete compensation of the unilateral total loss of vestibular function.

It is impossible—even with increasing surgical experience—to completely avoid a delayed postoperative facial palsy because the excision of Scarpa's ganglion interferes with the blood supply of the meatal segment of the facial nerve. On the other hand, difficulties in compensating the unilateral total loss of vestibular function can be avoided by proper selection of the patients.

The excision of Scarpa's ganglion is followed by a powerful bilateral suppression of vestibular activity (Fisch, 1973). This cerebellar inhibitory effect—which is stronger and longer lasting than that observed after labyrinthectomy—has the great advantage of reducing the activity of the vestibular system during the period of postoperative compensation and is at its maximum during the first postoperative month (acute phase of compensation). Later-on, in spite of a stabilized vestibular situation at rest, the response of the vestibular system to stimulation continuously evolves for as long as 3 years (chronic phase of compensation). The practical consequence of this situation is a rapid subjective compensation of the unilateral vestibular loss occurring during the first 4–8 postoperative weeks in four out of five operated patients. One out of five patients may experience occasional unsteadiness after acute stimulation of the vestibular system (such as rapid head movements, etc.) for as long as three years following surgery. Patients strongly motivated for reintegration in normal life highly appreciate the disappearance of episodic vertigo and disregard the occasional symptoms related to the compensation of the postoperative loss of vestibular function. As for labyrinthectomy (Simonton and Sciarra, 1958, and Pedersen and Sorensen, 1970), the mental constitution of the patient is more important for the rate of recovery after surgery than age, duration of symptoms, and type of hearing loss. There is however one category of individuals presenting objectivible difficulties in compensating the loss of vestibular function produced by vestibular neurectomy. These patients show the typical symptoms and findings of Menière's disease associated with signs of central vestibular dysfunction (disorganized and monotonous caloric response with dysrhythmia of the central type and no clear-cut maximum response period). The patients with central vestibular symptoms associated with Menière's disease are on the average 10 years older than those having Menière's disease only (54·9 years versus 44·8 years), have a high tone hearing loss with flat discrimination curve and an average maximal discrimination loss of 60 per cent (versus a loss of 36 per cent in Menière's disease). If Meniére's disease is associated with a central vestibular dysfunction, we avoid sectioning the vestibular nerve and rather perform a large circumferential exposure of the internal audi-

tory canal, remove intrameatal arachnoidal scars, drain the cerebro-spinal fluid from the lateral cistern and transpose the superficial temporal artery over the meatus. The aims of this operation are:

(a) to re-establish a free circulation of the cerebro-spinal fluid between the lateral cistern and the internal auditory meatus, and

(b) to possibly increase the vascularization of the internal auditory canal.

There is evidence (Table IV) indicating that the protein content of the

TABLE IV.
PROTEIN AND K CONTENT OF THE CSF IN THE I.A.C.

Diagnosis	Patient	Sex	Age/yrs.	Protein mg. %	K mval/1
Menière's Disease	O.A.	f	39	9·0	2·7
	K.G.	m	54	18·6	2·7
	S.M.	m	51	18·6	2·7
	F.C.	f	34	27·0	5·4
	V.A.	f	65	27·2	2·3
	Z.R.	f	65	31·5	2·3
	P.W.	m	67	31·5	2·3
	S.R.	f	45	32·9	1·2
	S.M.	m	49	35·7	3·0
Menière's Disease and central vestibular dysfunction	P.R.	f	53	14·3	3·8
	A.K.	m	54	18·6	2·7
	S.R.	f	44	42·9	4·2
	G.G.	f	50	52·4	3·8
	K.D.	f	47	52·9	1·92
	M.V.	f	44	85·1	3·8
	S.R.	m	60	86·4	2·7
	O.M.	m	30	160·0	2·7
	F.R.	f	57	180·0	3·0

Protein and potassium content of the cerebrospinal fluid in the internal auditory canal of patients with typical Menière's disease and Menière's disease with associated central vestibular dysfunction. Note that values of more than 30 mg. per cent are considered abnormal according to the method used. Seven out of nine patients with signs of central vestibular dysfunction presented abnormal protein values in the internal auditory meatus. The potassium determinations have been used to exclude contamination with blood in the examined samples.

meatal cerebro-spinal fluid in patients with Menière's disease and associated central vestibular dysfunction is abnormally high in spite of normal intralumbar values. It is therefore reasonable to assume that the high protein level measured in the internal auditory canal might influence the inner ear fluids through the perineural spaces in the same manner as an acoustic tumour does. The surgical drainage of the cerebro-spinal fluid from the lateral cistern through the meatus may therefore contribute to normalize the inner ear fluids. Whether the transposition of the superficial temporal artery with its surrounding tissue can improve the intrameatal vascularization, still awaits experimental proof. The favourable clinical results accumulated so far have however encouraged us—in spite of the insufficient follow-up time—to continue along this line in patients presenting with Menière's disease and associated signs of central vestibular dysfunction.

Our experience with vestibular neurectomy can be summarized as follows:

The operation requires special oto-neurosurgical training, relieves the patients from episodic vertigo in 94 per cent of the cases, preserves hearing in 80 per cent, diminishes tinnitus and pressure in the ear in 66 per cent and 63 per cent respectively of the cases, carries the risk of deafness in 4 per cent of the cases, of a delayed but reversible facial palsy in 3 per cent of the cases, and of a difficult compensation of the total unilateral loss of vestibular function in patients with insufficient motivation for reintegration into normal activity or in patients having signs of central vestibular dysfunction.

Cochleo-vestibular neurectomy and labyrinthectomy

If the hearing loss is total, cochleo-vestibular neurectomy is the operation of choice. This procedure is mostly performed through a translabyrinthine approach. The transtemporal route through the middle cranial fossa is only used when a radical cavity is present. An extended type of transmeatal labyrinthectomy (Pulec, 1974) is reserved for the few patients in whom general anaesthesia is contra-indicated. The *surgical technique* used for the translabyrinthine cochleo-vestibular neurectomy is well known. The excision of the meatal segment of the vestibular nerve and of the cochlear nerve is performed in order to have an irreversible degeneration of the VIIIth nerve (Fig. 3, A). The exposed internal auditory canal is covered at the end of the procedure with lyophilized dura*), fixed in place with 'Histoacryl' glue**) (Fig. 3, B). Following the removal of the incus free muscle grafts are placed in the aditus and vestibule to avoid C.S.F. leaks through these areas. The remaining cavity is filled with adipose tissue from the abdominal wall.

The *complications* observed after cochleo-vestibular neurectomy were limited to one instance of transitory C.S.F. leak occurring through the retro-auricular wound.

The *results* obtained 5 years following cochleo-vestibular neurectomy are shown in Table V. The operation was considered successful by 92 per cent of the patients. The symptoms of episodic vertigo disappeared also in 92 per cent of the cases. Tinnitus disappeared or decreased in 75 per cent and pressure in the ear in 83 per cent. Fifty per cent of the patients had previous surgery. In 4 patients treated with repeated labyrinthectomies the vestibulum and the posterior semi-circular canal were found to be filled with scar neuromas arising from the area of the posterior ampullary nerve. All these patients lost their vertigo following the excision of the meatal segment of the VIIIth nerve. This observation supports the view that scar neuromas in the region of destructed vestibular end-organs

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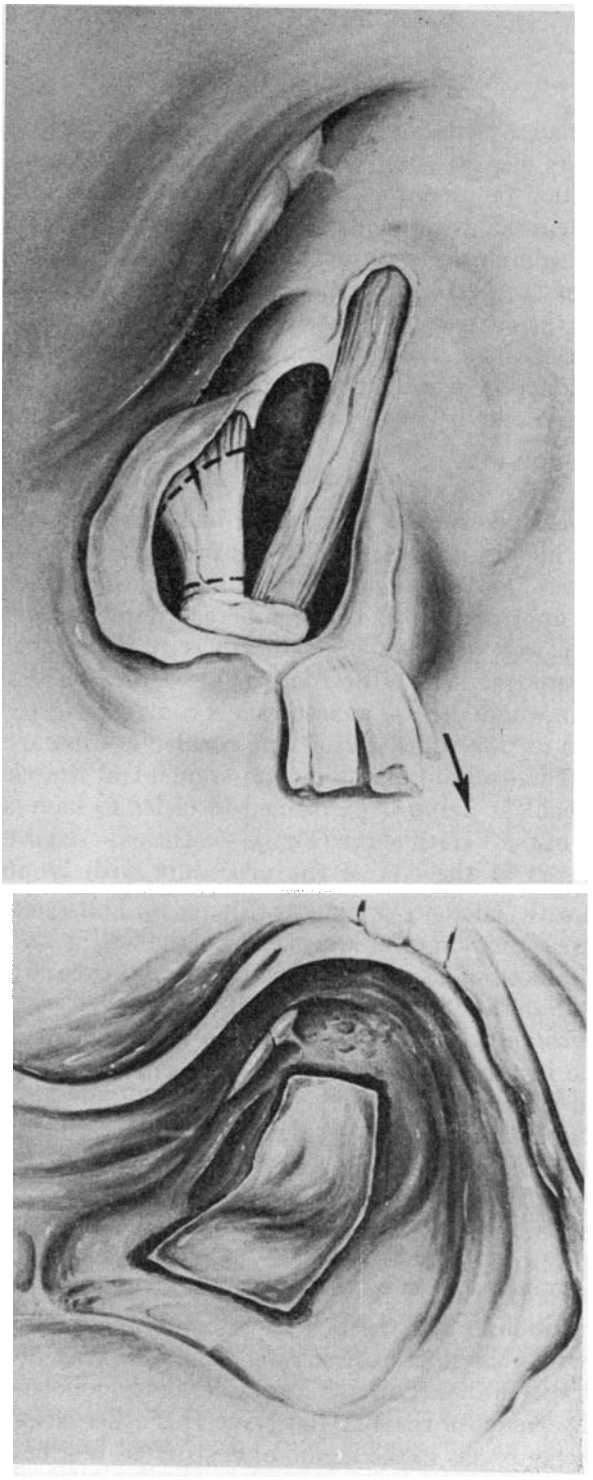

FIG. 3.

Cochleo-vestibular neurectomy.

A: The meatal segment of the vestibular nerve has been excised. The lines of excision of the cochlear nerve are visible.

B: The exposed internal auditory canal is closed at the end of the procedure with lyophilized dura fixed in place with 'Histoacryl' glue.

TABLE V.

COCHLEO-VESTIBULAR NEURECTOMY: 5 YEARS' FOLLOW-UP RESULTS IN 12 PATIENTS*

Successful	(subject)	11/12	92%	
Vertigo	gone	11/12	92%	
Hearing	lost	12/12	100%	
Tinnitus	gone	4/12	33%	75%
	improved	5/12	42%	
Pressure	gone	3/6	50%	83%
	improved	2/6	33%	

5 years' follow-up results in 12 patients submitted to cochleo-vestibular neurectomy.

* 6 Patients had previous surgery: repeated labyrinthectomies (4 cases), ultra-sound (1 case), vestibular neurectomy (1 case).

may be responsible for the persisting inbalance observed after labyrinthectomy. The only patient complaining about persisting vertigo after cochleo-vestibular neurectomy had been operated previously—as mentioned above—by an unsuccessful vestibular neurectomy. We cannot explain why the symptoms of Menière's disease remained unchanged following the complete section of the VIIIth nerve.

In summary, cochleo-vestibular neurectomy is an oto-neurosurgical procedure requiring a good knowledge of the temporal bone anatomy, eliminating vertigo in 94 per cent, reducing tinnitus in 75 per cent of the cases, and carrying the risk of a C.S.F. leak in 3 per cent of the cases.

If there is no medical treatment capable of curing Menière's disease, there is no surgical procedure either capable of achieving this goal. Since the etiology of Menière's disease remains unknown, only the symptoms of the disease (episodic vertigo, hearing loss and tinnitus) can be treated. Vestibular neurectomy and cochleo-vestibular neurectomy are certainly the most efficient surgical procedures which can be used against the symptoms of vertigo in irreversible Menière's disease. Saccotomy with myo-synangiosis gives less reliable results, but can still be recommended because of its simplicity to treat the initial and reversible stage of the disease. The choice of either one of the above mentioned procedures has to be made according to the careful evaluation of the severity of vertigo and of the extent of the hearing loss, tinnitus and pressure experienced by the patient. One must be aware that in spite of the existence of general criteria for a selection of the most appropriate surgical procedure, each individual patient may present with particularities imposing exceptional solutions. Since the results of surgery entirely depend on the proper evaluation of the individual situation, only the long-term experience with the available procedures is the prerequisite for the right surgical decision. This is the reason why instead of presenting high figures with a short follow-up, we have chosen to show our 5 years' experience in a limited number of cases.

Summary

The 5 year follow-up results obtained by the surgical treatment of 90

patients suffering from Menière's disease are presented. Saccotomy with myo-synangiosis was carried out in presence of a reversible Menière's disease (fluctuant hearing loss with normal hearing in the intervals of the disease). The operation, which is easy to perform, relieved 50 per cent of the patients from their symptoms and carried the risk of total deafness in 4 per cent of the cases. Vestibular neurectomy was the operation of choice for the irreversible stage of the disease when hearing was still useful. The operation, which requires special oto-neurosurgical training, relieved the patients from episodic vertigo in 94 per cent of the cases, preserved hearing in 80 per cent, reduced tinnitus and pressure in the ear in 66 per cent and 63 per cent respectively of the cases, carried the risk of deafness in 4 per cent, of delayed but reversible facial palsy in 3 per cent. Vestibular neurectomy was followed by difficulties in compensating the postoperative unilateral loss of vestibular function if poor motivation for reintegration into normal activity or central vestibular dysfunction were present. Cochleo-vestibular neurectomy was carried out in patients with a total loss of hearing. The operation, which requires a good knowledge of temporal bone anatomy, eliminated vertigo in 94 per cent, reduced tinnitus in 75 per cent of the cases, and carried the risk of C.S.F. leak in 3 per cent of the cases.

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